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THE HIGH AND LOW STAGES OF THE MISSISSIPPI RIVER DURING THE YEAR 1906-7.*

BY

ROBERT M. BROWN.

The stages of the Mississippi River during any year are, in general terms, a falling stage which extends from about June 1 to the end of the year and a rising or flood stage which controls the river during the early months of the year. During the low stages, the work of the engineers is centered on a navigable channel, while protection to the inhabitants of the basin and their properties is the aim during the flood stages. The stages of the river were remarkable during the year 1906-7 for the comparatively high stages of the low-water season, and for the early culmination of the flood stage.

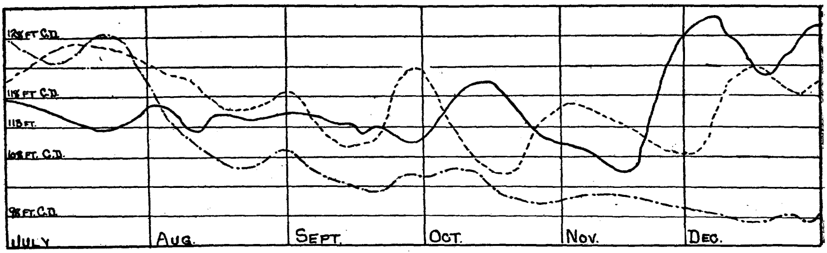

FIG. 1—HYDROGRAPH OF THREE LOW-WATER SEASONS AT LAKE PROVIDENCE.
——— 1906. — — — — 1905. —.—.—.—. 1904.
C. D. = CAIRO DATUM.

The Low-water Season.—The river did not reach a very low stage during 1906. The lowest stage of the season was registered on November 16, when the Cairo gauge read 11.9 feet. During 1905, the lowest reading at this station was 11 feet, October 18; 1904, 3.1 feet, December 25. A study of the accompanying hydrographs of the low-water stages for the three seasons above mentioned at Lake Providence will show the variation of the river stages. During 1904, an almost consistent drop in stage is recorded to the end of December when the rise began. The 1905 hydrograph fluctuates throughout the season and reaches its lowest stage near the middle of October. The 1906 low-water season ended abruptly on November 16 by a sudden rise, and at no time during the season was there a shortage of water. The work done by the dredges during 1906 was considerable, however. A secondary rise of the river during the falling stage is generally strong enough to move the sand along the bottom into the channels. Thus these rises, while they furnish an additional supply of water and frequently come at an opportune time to relieve the embarrassment of the engineers, are not always unalloyed blessings. The October rise of the river (see hydrograph) increased the demand for dredging.

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* Compiled, largely, from the annual report of the Mississippi River Commission for the year ending June 30, 1907.

In consideration of the interest recently developed in the use of the river as a highway, the Commission is looking forward to an enlargement of its policy. As long as the protection of the inhabitants of the alluvial basin was a focal point of the work of levee construction and maintenance, the vision of a completed system was fast becoming a reality. It was to be expected that new levees would be required from time to time. In fact, the average life of the levees was reckoned at twenty years. By building the new levees at some distance from the banks they have in many instances out-lived their allotted time. This policy exposes the old banks to erosive action and thereby a constant source of detritus results. The low-water navigation is obstructed by the deposit of sand bars in the reaches of the river. If the scour on the deserted and exposed levees is prevented, the supply of bar-building materials will be diminished. Thus has arisen anew the recommendation for revetments for the protection of levees. The revetments, the Commission states, are such expensive works that it is only in extreme cases that use of them is permissible for the mere protection of levees. But now that the navigable channel is a desideratum the revetments, expensive though they are, must be considered as a method of preventing scour and the filling of the channel with sediment. The Commission directs the attention to Plum Point and the Lake Providence reaches where for sixteen years a plan of bank revetments was successfully pursued in order to regulate the low-water width of the river. This work, which was in the original plan of the Commission, had to be abandoned because of the limited appropriations. If the Commission is committed to the plan of holding the river in its present channels, as soon as hard and fast banks are made, the better for all interests along the river. The abandonment of a levee because of its threatened destruction and the building of a new levee farther back from the river not only must furnish the river with a large supply of sediment, but also by the shifting of the river by ever so slight an amount must cause a scour in new and unprotected spots up and down stream from the abandoned levee.

It is not expected that such a policy will in any way put the dredging plant out of service. Neither dredging nor revetments of exposed levees alone can possibly supply the required navigable depth of waterway. Commissioner Taylor says,* in regard to the feasibility of maintaining a 14-foot channel by dredging, that with the present method and existing conditions the work would be enormous. The other extreme would be to make the sand bars so slight by revetting all the banks south of Cairo that dredging would not be necessary. This would demand according to Taylor a $100,000,000 appropriation at the outset. A combination of dredging and revetments, whereby scour will be diminished and less material be found in the bed of the river for the formation of bars seems to be a safe mean.

The success of the engineers in maintaining the required channel has not been met, however, with much response in the use of the river as a highway. "The failure of commerce to respond to the improved conditions of the channel which have been maintained for a number of years past is disappointing. It can be accounted for only on the theory that confidence in the permanence of the improvements still hesitates. To go on to more perfect mastery of the conditions, to hold the banks with greater security, to build and operate more powerful dredges if need be, and to increase the depth of the channel from year to year, will invite and stimulate that confidence without which the restoration and, much more, the large expansion of commerce on the river will be impossible."†

High Water Stages.—The flood of 1907 may be classed with the great floods. It was remarkable in the fact that a high stage was reached early in the year. The low-water season ended November 16, 1906. The river rose rapidly and in January, 1907, the gauge at Cairo recorded the highest stage experienced for that month, and the reading lacked only 1.8 feet of the highest known stage at that station. Unusually heavy rains occurred over the basin of the Cumberland, Tennessee and Upper Ohio rivers during January. The continuous character of the rain and the increased percentage of run-off, which generally obtains at this season of the year because of the frozen condition of the ground and the lack of most vegetative checks, so filled the Ohio River that the highest known stage of that river was nearly reached. This flood, emptying its waters into the Mississippi at a time when the river was at a comparatively high stage caused the rise of the river almost to the danger point. It is always interesting to note how fine the line is between disaster and safety. If we can count on compensating occurrences to arise at every bank-full stage our levee system is safe. In times past, the limited area of rainfall has saved the levees; in 1903, the low stage of the river just before the flood rise was beneficial; in 1907, a cold wave came on and checked the rise in all the tributaries north of Cairo. The engineers of the first district laboured with difficulty in almost continuous rains and prevented a break into the White River basin by great efforts. Had not the weather turned cold on February 3 they infer that in spite of their labours a break would have occurred. As it was, the levees of the district were topped. The arrival of the cold wave prevented a greater flood and, furthermore, so checked the supply of water that the flood was of short duration in the upper portion of the flood plain area.

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* Taylor, R. S., "The Present Aspect of the Mississippi River Problem."

† p. 2624, Report of Commission, 1907.

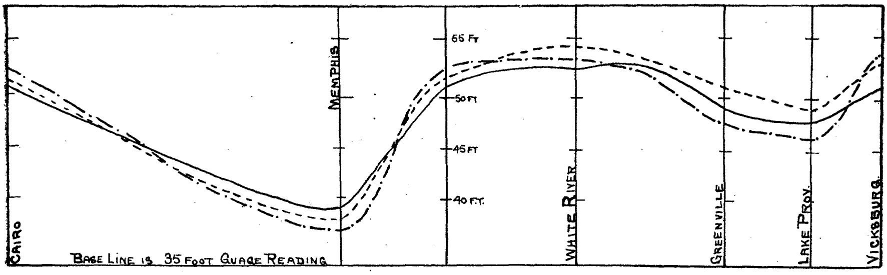

FIG. 2—PROFILE OF FLOOD CRESTS, CAIRO TO VICKSBURG.
——— 1907. — — — — 1903. —.—.—.— 1897.
VERTICAL SCALE EXAGGERATED.

The record in crevasses is remarkable. For a number of years the yardage of levees lost by flood has gradually diminished and during the 1907 flood but one crevasse occurred. This was about 28 miles below New Orleans in a location where no harm resulted. So unimportant was this break that the engineers decided not to close it at once, as the exposed ends had been protected from further wear and the river was falling. The loss by this one crevasse was about one-half of one per cent. of the contents of the existing levees. During 1906 the loss was nine-tenths of one per cent. During the flood of 1903 the loss was a little less than one per cent.

In comparing the 1907 flood with the 1903 and 1897 floods, figure 2, which is a profile of the three flood crests from Cairo to Vicksburg, shows a marked deviation from parallelism. The lower stage of the 1907 flood in comparison with the 1903 flood at White River and Vicksburg is accounted for by the low stage of the tributaries at these stations, which allowed the flood to spread by running up the comparatively empty river beds. In other cases the departure from parallelism may be explained by the suddenness of the rise and fall and by the contraction or expansion of the river bed by the removal or replacement of dikes and levees. During March and April, a secondary rise of the river occurred which excelled the January rise in some portions of the Ohio River, but which fell four feet short of the first rise at Cairo.

WORCESTER, MASSACHUSETTS.

KASSNER'S METEOROLOGICAL GLOBES.*

BY

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I wish to call the attention of my colleagues of the Association of American Geographers to a new and, as it seems to me, valuable addition to the teaching equipment now provided in meteorology and climatology. Every teacher of these branches of science, and of physical geography in the large, has had frequent occasion to regret that the great facts of temperature, pressure and prevailing winds have to be learned from charts which, especially if these are on the Mercator projection, as is often the case, are very apt to give the student a distorted or unreal picture of the actual meteorological conditions, as well as of the relative sizes of the zones. Professor Kassner, who is one of the officials of the Royal Prussian Meteorological Institute in Berlin, and *Privatdocent* at the *Technische Hochschule* there, has recently constructed two "meteorological globes" which can be most highly recommended for use wherever meteorology and climatology are taught. These globes, which measure 34 centimetres (nearly 13½ inches) in diameter, show the temperature, pressure and prevailing winds for January and July on the basis of the latest and most complete data available up to the spring of 1907. The globes are well mounted, at the proper inclination, on a wooden base. A simple and very useful device makes it possible to turn

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* Read by title before the meeting of the Association of American Geographers, held at Chicago, Ill., December, 1907.